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PHYSICOCHEMICAL AND ORGANOLEPTIC QUALITY OF CHICKEN FRIED MEATBALLS BROILER USING FLOUR IS DIFFERENT

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ABSTRACT

Climate change nowadays became the most problematic matter including in agricultural industries. Agriculture area productivity affected national food security and a county's economic development. As an agricultural county, Indonesia must be ready to adapt and prepare for the worst impact of climate change. This paper aims to explore the impact of climate change on financial sustainability in agricultural industries. This research uses a systematic literature review method related to financial sustainability, climate change impact, and agriculture industries. The result shows that financial sustainability in agricultural industries must be impacted by climate change. The impact of climate change on agriculture industries is associated with reducing profitability, destroying capital, portfolio reallocation, and financial instability. Climate change caused environmental uncertainty that affects agricultural productivity. To reduce the impact of climate change on financial sustainability in agricultural industries, there must be a design of mitigation must be prepared and realized so agricultural industries are more prepared and ready to face climate change impact.

Keywords: Agricultural Industries, Climate.

INTRODUCTION

Nutritional needs can be fulfilled through protein sources in broilers, which are in great demand by the public, including broiler chickens, free-range chickens**,** and rejected laying hens. Broiler chicken meat has economic characteristics with fast growth and has soft fiber, low feed conversion, and is ready to be cut at a relatively young age (Mlaga K G, et,al., 2022, Alkhtib A, et, al., 2023 and Islam M A, et, al.,2022) . Increasing the usability of broiler chicken meat needs to be processed into processed products of higher quality and preferred by consumers, including meatballs.

Meatballs are processed meat products from both poultry and ruminants (Hsu S Y and Sun L Y, 2006). Meatballs are processed meat products that have been mashed beforehand and mixed with

meatball dough and flour, after which they are shaped like small balls and then boiled in hot water (Kilic S, Oz E and Oz F, 2021). Meatballs in Indonesia are currently very important because th**is** product has a high animal protein content, minerals**,** and vitamins.

Types of processed meats with protein, such as fried meatballs, are typicall**y** processed food products from the Bandung area. Fried meatballs are usually made from several types of livestock, such as beef, chicken**,** and fish meat. Fried meatballs are different from meatballs in general. Meatballs are usually served with hot sauce, while fried meatballs are a snack with a crunchy texture and can be eaten as a snack. The difference between fried meatballs and other meatballs is how they are served, namely through boiling and frying. Frying aims to extend the shelf life of food by reducing water activity and inhibiting bacterial growth by reducing the water content in the meatballs to produce savory fried meatballs.

This research will specifically break down the quality of fried meatballs with different types of flour, such as tapioca, mocaf, sago flour, and cornstarch, to test the stickiness in making fried meatballs. Therefore, innovation is needed to create new food products with high nutritional value and suitable for consumption. Based on this, research has been carried out on adding different types of flour to physicochemical quality, pH value, cooking loss, water holding capacity, and swelling power. In contrast, organoleptic qualities include color, shape, texture, aroma, taste, elasticity**,** and general acceptance.

MATERIALS AND METHODS

Tools and Materials

The research was carried out at the Faculty of Animal Science, Haluoleo University, Kendari Laboratory, for one month (November 2022). The equipment used for making meatballs consists of a meat grinder (food processor), pH meter, plastic clips, label paper, bowls, freezers, digital scales, several cups, water baths, scissors, blenders, basins, spoons, cutting boards, stoves, pots, pans, and other cooking tools. The main ingredients are fresh meat, tapioca flour, mocaf flour, sago flour, and cornstarch. The ingredients for the meatball dough (support) consist of tapioca flour, garlic, salt, ground pepper, ice cubes, and cooking oil.

Making Process.

Making fried chicken meatballs applies 5 levels of treatment with 5 repetitions, namely adding 10% filler. The making of chicken fried meatballs in the research was whole chicken meat that had been filleted and separated from the skin and internal organs. The meat is cleaned, cut into small pieces, and then ground using a food processor. In the first grinding, 5.2% ice cubes were added by the weight of the meat, 10% flour was added with a different type for each treatment, 2% garlic, 1% ground pepper, and 2% flavoring, then formed meatball spheres and boiled for 15 minutes. At a temperature of 70- 80ºC and frying the meatballs at 70-80ºC.

Research Design.

The experimental design used was a completely randomized design (CRD) using 5 treatments and 5 replications with 10% filler consisting of P1 = tapioca flour, P2 = mocaf flour, P3 = sago flour, P4 = cornstarch, and P5 = rice flour. The variables to be observed are the physicochemical qualities which consist of pH, cooking losses, water holding capacity, and swelling capacity. In contrast, organoleptic qualities include color, shape, texture, aroma, taste, elasticity, and general acceptance.

Data Analysis.

The data to be obtained will be analyzed using Analysis of Variance (ANOVA) or a Completely Randomized Design (CRD). Furthermore, if the treatment shows a significant effect, it continues with the Least Significant Difference Test (LSD) and the Duncan Multiple Range Test (DMRT).

RESULT AND DISCUSSION

Physicochemical quality of meatballs.

Observations on the physicochemical quality tests in the form of acidity (pH), water holding capacity, cooking loss, and swelling are the physicochemical properties that affect the quality of the meatballs, so it is necessary to know how the changes in these physical properties after the cattle are slaughtered (Amalia L, et, al., 2022 and Shen J, et, al., 2023) . Average observed data (Table 1) on the physicochemical properties of pH value, cooking loss, water holding capacity, and swelling capacity of broiler chicken fried meatballs using different types of flour.

***pH* (*acidity*).** The results of observations of making broiler chicken fried meatballs with different types of flour showed an average pH value ranging from 6.28–6.44 with an average percentage of 10% flour in each treatment, namely tapioca flour 6.44 and the lowest was found in the percentage of mocaf flour, namely 6.28 so that in each treatment with the administration of different types of flour it had a significant effect (*P<0.05*), on the pH value of broiler fried meatballs. Meatballs from different types of flour greatly affect the pH of fried meatballs, presumably due to the high protein of chicken meat, so the meatballs' pH has a significant effect and tends to increase. This is also possibly influenced by the basic ingredients used, namely meat and flour (Nullah L N, Hafid H and Indi A, 2016).

Table 1. Means of fried meatballs for broiler chicken meat using different types of flour on physicochemical quality.

Variable	Flour Type				
	Tapioca flour	Mocaf flour	Sago flour	Cornstarch flour	Rice flour
pH	6.44^{b}	6.28^{a}	6.32^{a}	6.30^{a}	6.36^{ab}
Shrink Cooking	1.60^{a}	1.20^{a}	4.60^{a}	5.80^{a}	4.40^{a}
Water Binding	76.65^{c}	47.43^{a}	79.68^{d}	68.73^{b}	79.73^{d}
Flower Power	1.40^{ab}	1.74^{c}	1.34^{a}	1.54^{b}	1.31^{a}

Note: Different superscripts on the same line show a significant difference (*P<0.05*).

Shrink cook. The addition of different types of flour (Table 1) had a very significant effect (*P<0.05*) on the meatball cooking loss. The Duncan test results obtained that P1 was significantly different from P3, P4, and P5 but not significantly different from P2, P3 was significantly different from P1, P2, and P4 but not significantly different from P5, and P4 was significantly different from P1, P2, P3, and P5. The highest cooking loss in broiler meatballs was found in cornstarch (P4), 5.80%, while the lowest was in mocaf flour (P2) 1.20%. This shows that the use of tapioca flour, mocaf flour, sago flour, cornstarch, and rice flour in each treatment significantly affected the cooking loss of broiler meatballs. The lower the value of cooking losses, the better the quality of the product because the loss of nutrients will be less. Conversely, the higher the value of cooking losses, the quality of the product will decrease.

The results of research on the manufacture of broiler chicken fried meatballs with different types of flour carried out a ratio of 80% meat and 20% seasoning, where the higher the addition of the level of cooking shrinkage flour, the lower or less. The lower the cooking shrinkage value, the better the product quality because the loss of nutrients will be less. Conversely, the higher the cooking loss value, the product quality will decrease (Serdaroğlu M, et, al., 2005).

Water binding. The results of measuring the water-holding capacity of meatballs (Table 1) show an average value ranging from 47.43% -79.69%, with an average percentage of 20% for each type of mocaf flour (47.43%) and the highest average for sago flour (79.69 %). The analysis of variance had a significant effect (*P<0.05*) on the binding capacity of broiler meatballs. Sago flour contains high starch and has an affordable price, so it can be used as a substitute for making chicken meatballs.

As a filler, a large amount of carbohydrate content in sago flour can bind water but cannot emulsify fat (Hsu S Y and Chung H Y, 2001,Hafid H, et, al,.2021). The binding power of meatball water is caused by protein concentration, pH level, ion concentration, and other factors. The protein concentration achieved is lower, and the amount of bound water decreases (Hsu S Y and Chung H Y, 1998, Muhamad Alfath F, et, al., 2022).

Flower power.The results of the analysis showed that the average swelling power of broiler meatballs with a different percentage of flour was between 1.74 g – 1.28 g, with an average flour percentage of 20% in each treatment, with the highest average being mocaf flour, which was 1.74 g and the lowest being rice flour, 1.31 g so that in each different treatment it had a significant effect (P<0.05) on the swelling power of broiler fried meatballs.

The results obtained after boiling experience expansion but after frying experience shrinkage due to reduced water content in the meatballs. This is also affected by cooking losses because temperature and cooking time can eliminate the weight of processed products. Products with a low percentage of cooking loss have relatively good quality compared to products with a higher percentage because they will lose nutrients during cooking.

Shrinkage of fried meatballs can occur due to the water content in fried meatballs. If the cooking or frying lasts longer, the water or water content will decrease. The water-holding capacity of meatballs is affected by protein concentration, pH value, ionic strength, and heating. The protein concentration in question is that the lower the protein concentration, the amount of bound water also decreases. The results of the swelling power test on broiler-fried meatballs from various types of flour experienced shrinkage. The lowest shrinkage ratio for fried meatballs was on sago flour 1.31 g.

Organoleptic quality, Assessment of organoleptic quality was carried out using the level of preference (hedonic) with a scale of 1-5 with a total of 25 semi-trained panelists with parameters tested (Table 2) including color, shape, texture, aroma, taste, elasticity, and general acceptance /favor.

Table 2. Average broiler chicken fried meatballs using different types of flour of organoleptic quality.

Variable	Flour Type				
	Tapioca flour	Tepung *Mocaf*	Tapioca flour	Tepung Maizena	Tapioca flour
Color	2.0^{b}	$2,0^{a}$	2.3^{c}	2.3^{b}	2.2^{b}
Shape	3.8	3.8	3.6	3.8	3.7
Texture	3.7	3.7	3.7	3.8	3.7
Aroma	4.1	4.16	4.12	4.12	4.08
Taste	4.0^{c}	3.9^{bc}	3.8^{a}	3.5^{ab}	3.5^{a}
Elasticity	3.7^{c}	3.8^{bc}	3.8^{a}	3.7^{ab}	3.6^{a}
General Acceptance	4.3^{d}	4.4^{c}	4.4^{b}	4.1^{ab}	4.0^{a}

Note: Different superscripts in the same line significantly differ (*P<0.05*).

Color. Color can provide an appeal that invites the tastes of panelists or consumers to taste a product. Color is the main component to determine a food ingredient's quality or degree of acceptance (Zwolan A, et, al., 2020). Analysis of variance showed that the preparation of fried meatballs with the addition of different types of flour had a significant (*P<0.05*) effect on the color of the fried meatballs.

The average result of the panelist's assessment of the color of the fried meatballs after the frying process was tapioca flour 2.0 white-brown, mocaf flour 2.0 brownish yellow, sago flour 2.3 light brown, cornstarch 2.3 light brown, and rice flour 2.2 tawny. The research results on each different flour type can affect the meatballs' color.

Shape. The shape affects the quality of the meatballs produced, especially when rounding the meatballs. There are certainly no parts of the meatballs that are still hollow. The way to make the meatballs perfectly round is to round them repeatedly to form a perfect ball.

The analysis of variance showed that broiler meatballs using tapioca flour, mocaf flour, sago flour, cornstarch, and rice flour had no significant effect on the shape of broiler-fried meatballs. The shape of broiler-fried meatballs at P1, P2, P3, P4, and P5 averages 3.6-3.8. This means that the shape of meatballs using different types of flour tends to be round because processed meatball products are generally round in shape.

Texture. The texture is a factor that influences the panelist's choice of a food product. The texture is most important in soft foods with smooth surfaces. The texture of meatballs is determined by the fat content, type of carbohydrates, and water content (Hsu S Y and Yu S H, 1999). The high-fat content will produce hollow meatballs that can affect the texture of the meatballs, while high water content will produce soft meatball textures.

The results of observations of broiler chicken meatballs using tapioca flour, mocaf flour, sago flour, cornstarch, and rice flour had no significant effect on the texture of broiler fried meatballs (*P>0.05*). This shows that all panelists gave the same response to all treatments, namely, the resulting fried meatballs had a smooth texture. The texture is a sensation associated with touch or touch. However, this property plays an important role in the formation of meat quality.

Aroma. Aroma is a parameter in testing sensory properties (organoleptic) using the sense of smell. The aroma can provide a subjective sensation that is produced by smell (smell). Aroma is a flavor (taste) that shows a pleasant or delicious aroma. In the aroma test, the senses that play a role are the sense of taste (tongue) and the sense of smell (nose) (Lestari M, et, al., 2022).

Analysis of the variance of making broiler-fried meatballs with different types of flour had no significant effect (*P>0.05*) on the aroma of broiler-fried meatballs. These results show that the use of different types of flour does not affect the aroma, with the average value of the aroma of fried meatballs ranging from 4.08 to 4.16, where P1-4.16 (tastes of meat), P2-4.16 (tastes of meat), P3- 4.12 (taste of meat), P4-4.12 (taste of meat) and P5-4.08 (taste of meat). The aroma of broiler chicken fried meatballs is similar to the taste of meat. Broiler chicken fried meatballs with various types of flour have a meaty aroma because the composition makes meatballs with a percentage of 60% meat and 20% spices so that the aroma still tastes like meat, and the panelists like the aroma.

Taste. Taste is a factor that influences the value of one's acceptance of a processed product (food) (Yeci I P, et, al., 2021). Taste is a determining factor for consumer acceptance of processed food products. The taste of the meatballs is formed by stimulation, sometimes also influenced by the aroma and taste.

Analysis of variance showed that preparing broiler-fried meatballs with

different types of flour had a significant effect (*P<0.05*) on the taste of broiler-fried meatballs. Different types of flour affect the taste of the meatballs with an average of 3.5 – 4.0. Panelists totaling 25 people with an average score of P1-4.0 (very meaty taste) were significantly different from P3-3.8 (moderately meaty taste), P4-3.5 (meaty-tasting enough), and P5-3.5 (moderately meaty), and P3 (slightly meaty) is different from P1 and P2 (meaty), where panelists prefer the taste of broiler chicken meatballs with tapioca flour (P1) and mocaf flour (P2) compared to sago flour (P3), cornstarch (P4) and rice flour (P5). This shows that panelists prefer fried broiler chicken meatballs with tapioca flour because the filler used in making meatballs is tapioca flour.

The highest results were obtained in P1, a meatball with a general flour type. This was because the panelists were not used to consuming meatballs with mocaf flour, sago flour, cornstarch, and rice flour. The taste is influenced by flour as a filler. Tapioca is a starch extract from cassava, so when it is cooked, the shriveled meat protein will be filled with starch molecules which can compact the texture and taste of the meat in the meatballs.

Elasticity. Elasticity is an attribute that is considered in assessing consumer preferences and acceptance of meatballs. Chewy meatballs will feel elastic when chewed (Efendi A, et, al., 2021). The results of observations of broiler chicken meatballs using tapioca flour, mocaf flour, sago flour, cornstarch, and rice flour had a significant effect on the elasticity of broiler fried meatballs (P<0.05). This shows that tapioca flour, mocaf flour, sago flour, cornstarch, and rice flour significantly differ from the elasticity of broiler chicken meatballs.

The elasticity of fried broiler meatballs P1, P2, P3, P4, and P5 averaged 3.6 – 3.8. The elasticity of meatballs using tapioca flour (P1), cornstarch (P4), and rice flour was quite chewy, while the elasticity of mocaf flour meatballs (P2) and sago flour (P3) was chewy. Duncan's further test showed that the P1 treatment differed significantly from the P2, P3, P4, and P5 treatments, while the P2 treatment was not significantly different from P3. The organoleptic test's mean score for broiler chicken meatballs' elasticity ranged from quite chewy to chewy. Panelists prefer meatballs that are chewy and do not break easily.

General acceptance. General acceptance or the so-called level of preference where panelists are asked for personal responses regarding likes or dislikes of a processed product. In this study, general acceptance consists of color, shape, texture, aroma, taste, elasticity, and general acceptance.

The results of observations of making broiler-fried meatballs with different types of flour had a significant effect (*P<0.05*) on the general acceptance of broiler-fried meatballs. The results of using different types of flour influence the general acceptance of broiler fried meatballs, with an average value ranging from 4.0 to 4.4. Of the 25 panelists, the average levels of P2 and P3 were higher with an average (4.4) than P1 (4.3), P4 (4.1), and P5 (4.0), where panelists preferred meatballs from mocaf flour and sago flour, this is because broiler chicken fried meatballs have the most preferred aroma with a brownish yellow color. After all, they have good taste.

CONCLUSION

The results of the study concluded that adding different types of flour significantly affected the physicochemical quality of broiler-fried meatballs, including pH, water holding capacity, cooking loss, and swelling power. The addition of different types of flour significantly affected the organoleptic quality of fried broiler meatballs, especially in color, taste, elasticity, and general acceptance. Still, it did not significantly affect shape, texture, and aroma.

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